ArcGIS Analysis and Visualization

Part I Working with Raster Data

Part II Analysis and Visualization Examples

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What the RSC Does.

Provide GIS assistance to ITAM supported Army installations and Army National Guard training sites.

RSC Mission:

To increase the utility and cost effectiveness of GIS support of the ITAM program through the development of standardized products and analyses.

RSC Services:

- **Technical Support**
- **Data Development**
- **GIS Analysis**
- **Map Production**

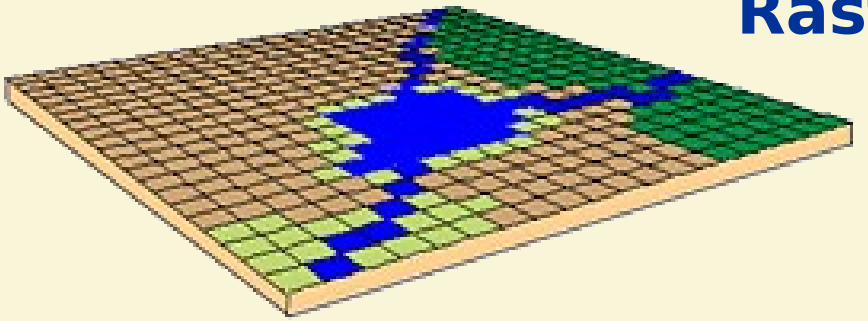
Presentation Goals:

- Introduce raster based GRID data.
- Introduce raster data in ArcGIS using the Spatial Analyst and 3D Analyst Extensions.
- Show real-world examples of raster data and the ArcGIS Extensions in action.

How does a GIS model the world?

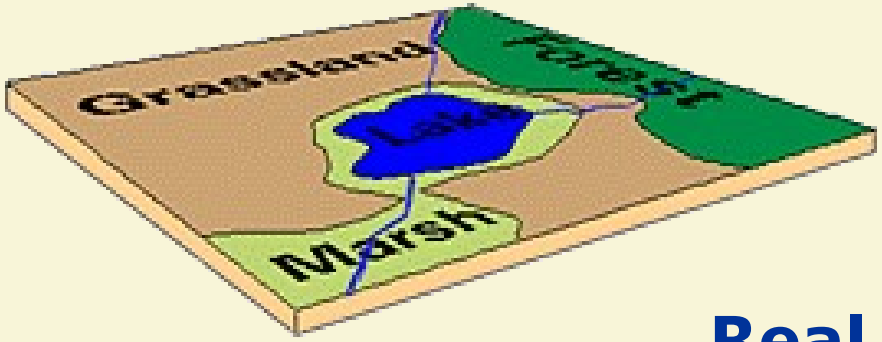
Cells or pixels

Raster

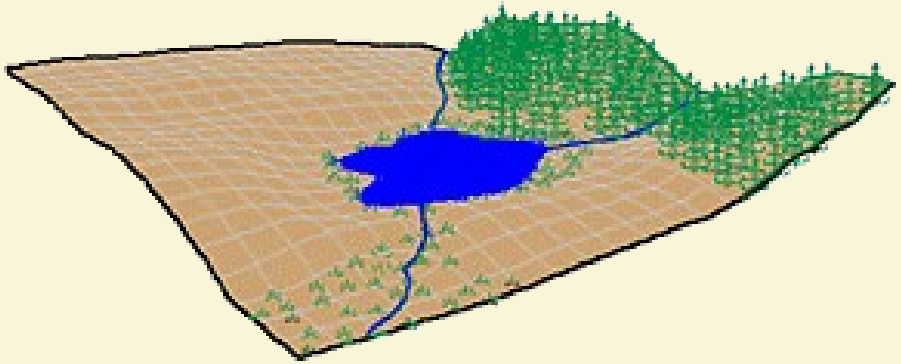


Points, lines and polygons

Vector

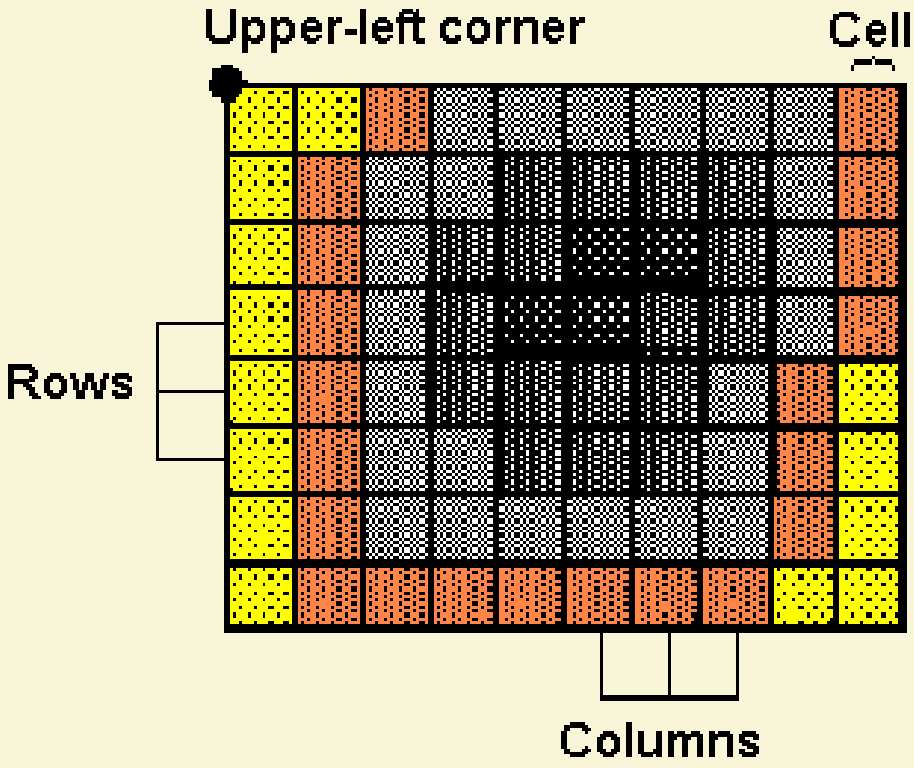


Real World



Anatomy of a GRID

Rasters - also called GRIDs - represent geographic features by dividing the world into discrete squares called cells.



Value	Fire Spread
1	Day 1
2	Day 2
3	Day 3
4	Day 4
5	Day 5

Types of GRIDs

Discrete -

- **Model features with definitive boundaries such as roads, buildings, vegetation, land use.**

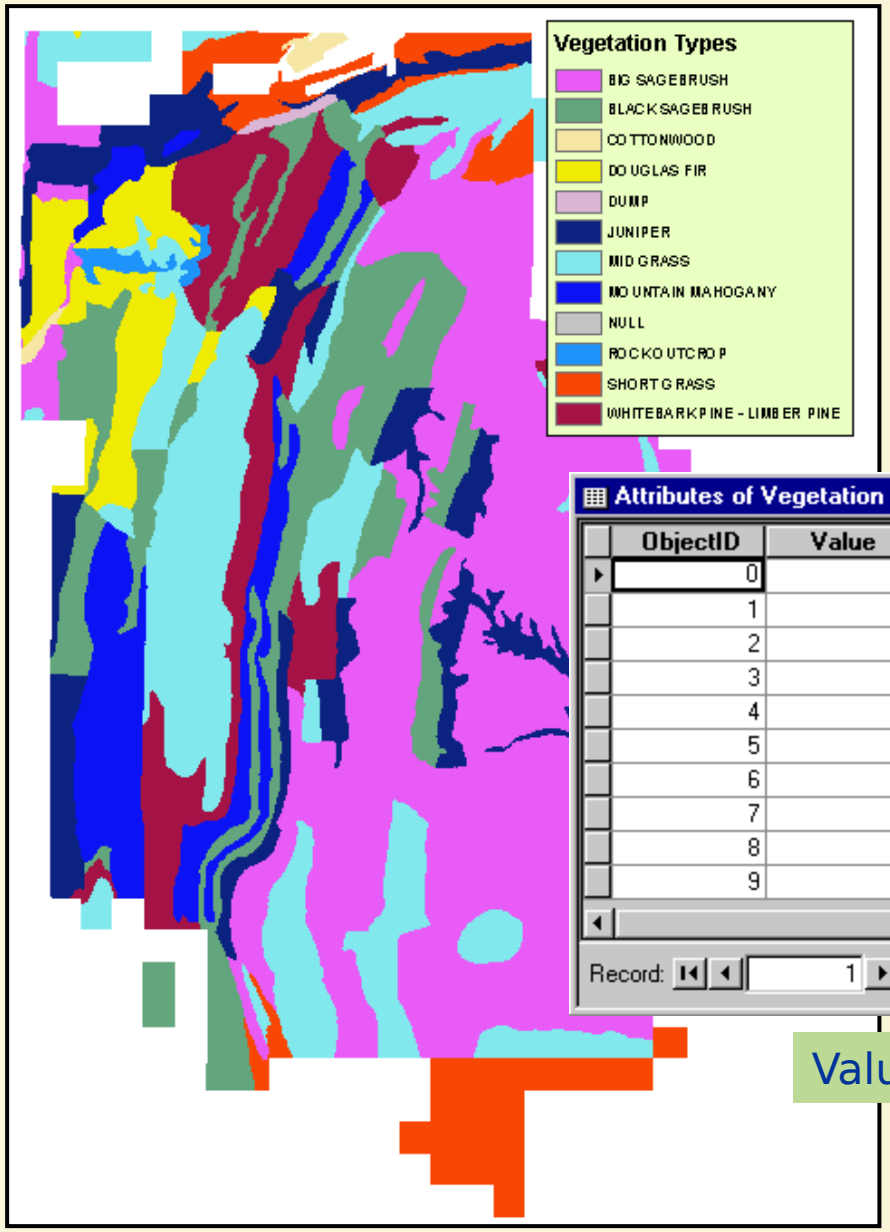
- **Cells must be represented with integer values.**

Continuous -

- **Model phenomena with indefinite boundaries such as elevation, aspect, noise levels, salinity.**

- **Cells are represented as real number values.**

Discrete Data GRIDs



A discrete object has known and definable boundaries.

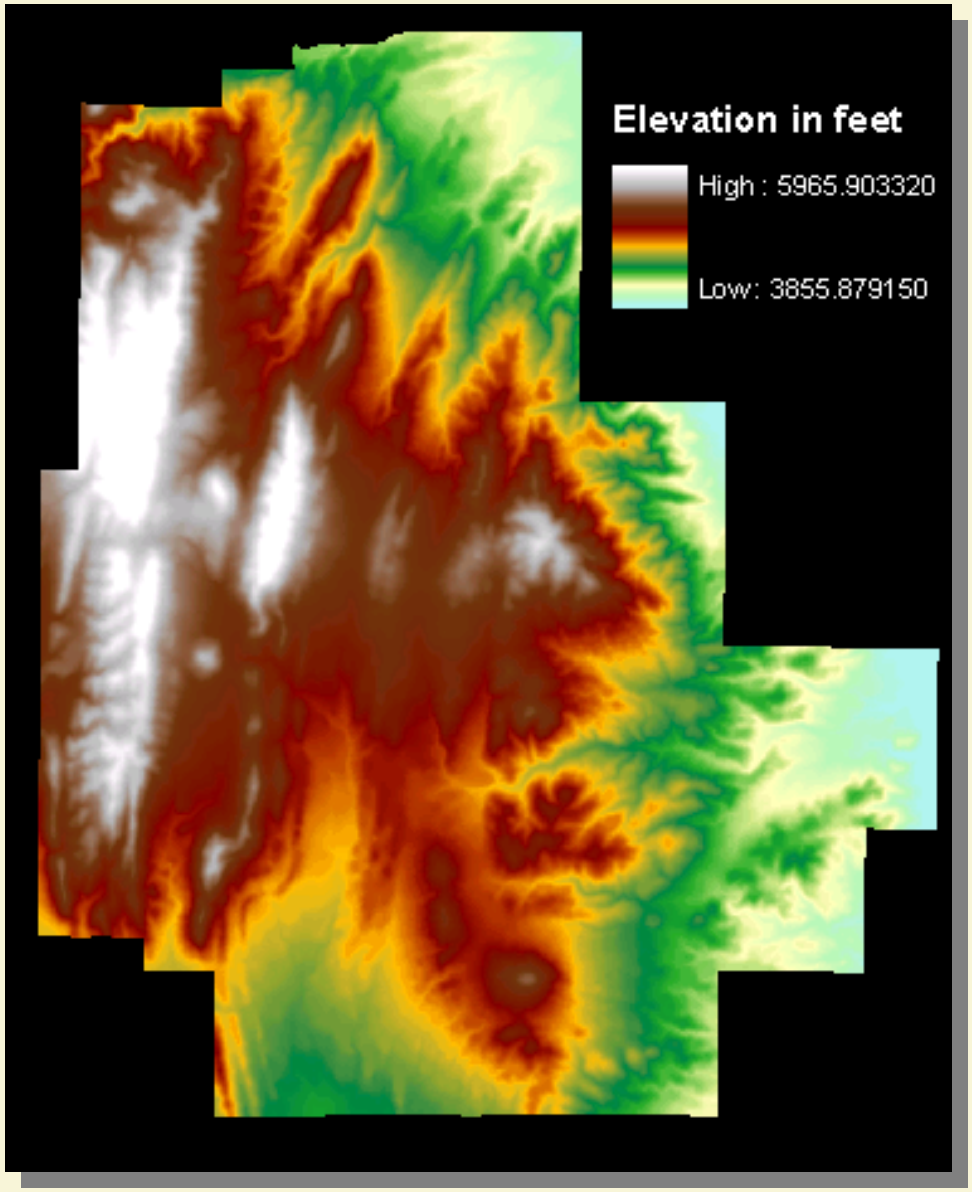
Attributes of Vegetation Types

ObjectID	Value	Count	Export_Output.vegcodef
0	1	9487	Mid Grass
1	2	2007	Douglas Fir
2	3	22049	Big Sage Brush
3	4	3114	Short Grass
4	5	170	Cottonwood
5	7	4720	Juniper
6	8	83	Dump
7	9	6068	Black Sage Brush
8	10	3910	Whitebark Pine - Limber Pine
9	11	3343	Mountain Mohogany

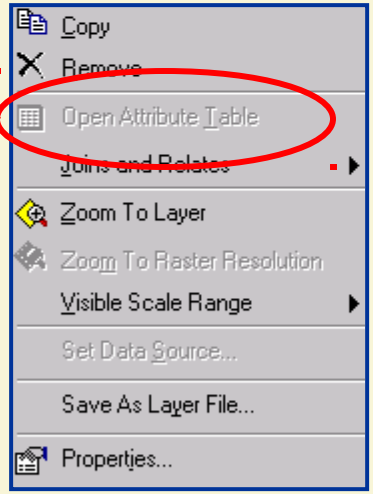
Record: 1 Show: All Selected Records (0 out of 10 Selected.) Options

Value attribute table is built. Values must be integ

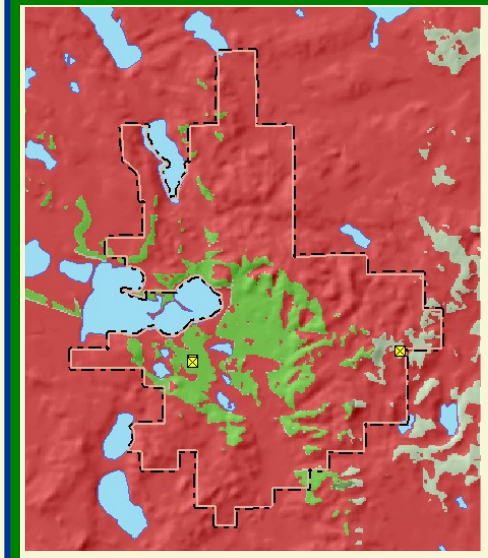
Continuous Data GRIDs



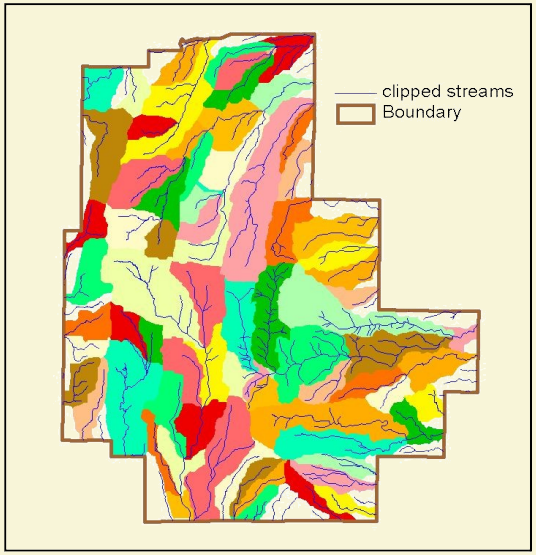
Continuous data have indefinite boundaries.



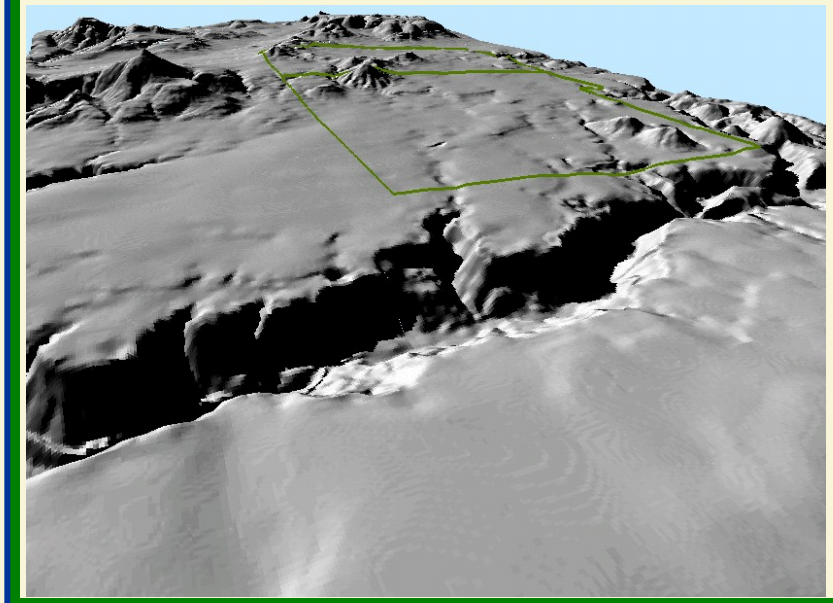
No value attribute table is built because each cell has a unique value.



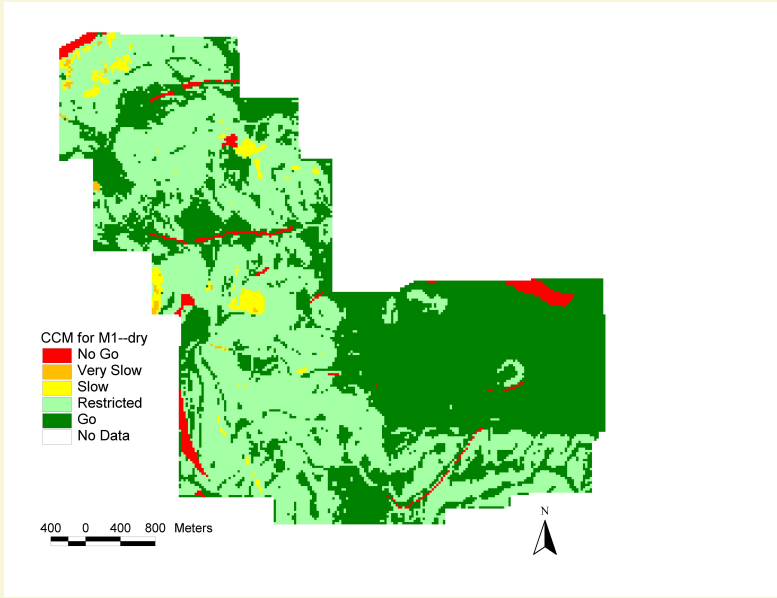
Raster Analyses Examples



- Viewshed analyses
- Topographic visualization



- Watershed delineatio
- Cross Country Mobilit



Why Use Raster?

- The ability to represent continuous surfaces.

- The ability to store points, lines, polygons and surfaces uniformly, as cells in a GRID.

- Geometric feature detection and topology building are not necessary.

- Mathematical computations are simple and efficient.

- Complex spatial operations, such as viewshed analysis, 3D modeling, and cost analysis, may be performed.

Raster Drawbacks

- Raster maps inherently reflect only one attribute or characteristic for an area.

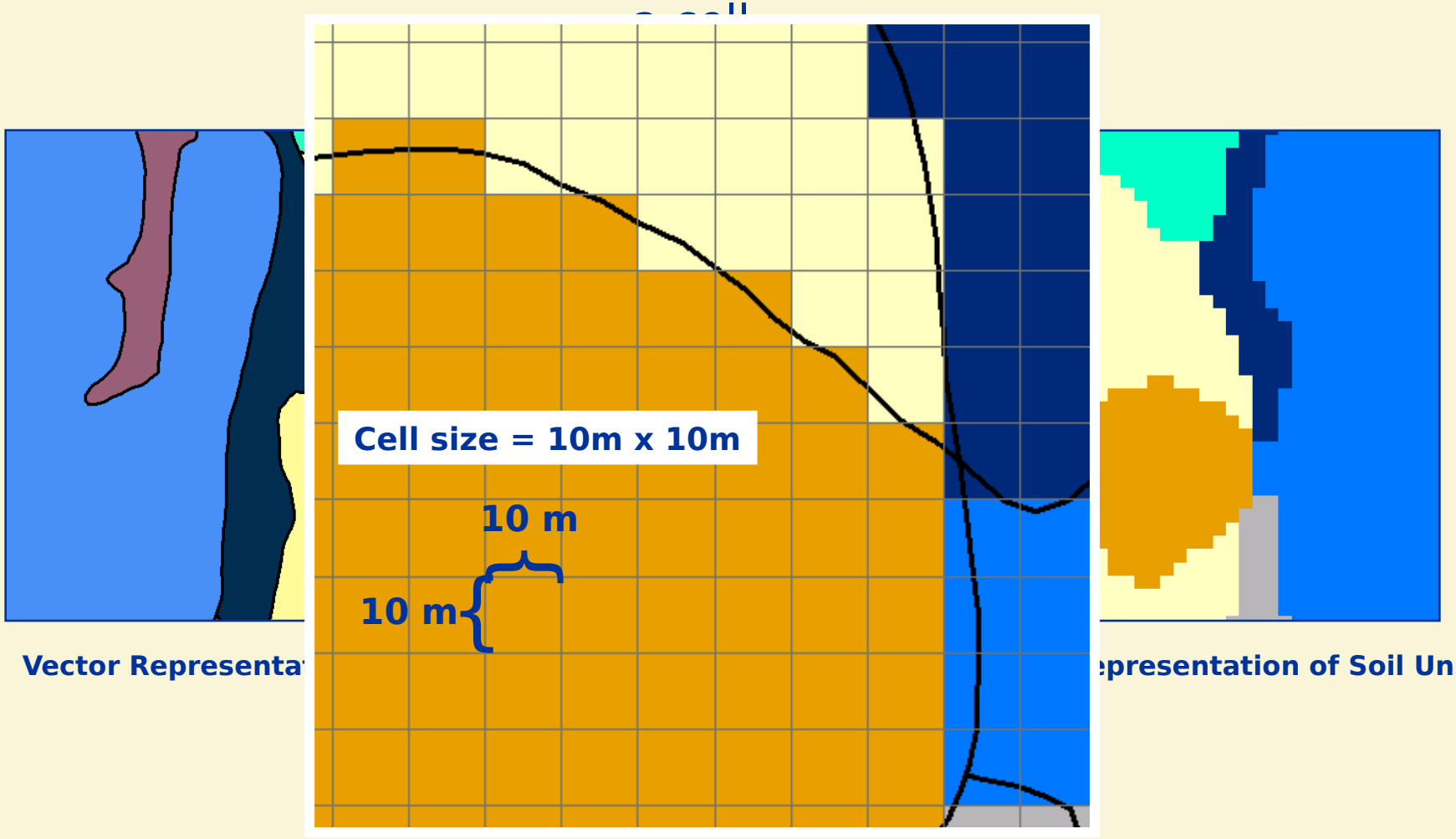
- Most data is in vector form, it must undergo vector-to-raster conversion in order to convert it to a GRID.

- Does not look as good as vector data when used in high-quality cartography.

- The value of a GRID must be numeric. Requires coding of values in order to model non-numeric features, such as land-use or soils.

Raster Drawbacks

Accuracy is sacrificed when representing a feature as a cell.

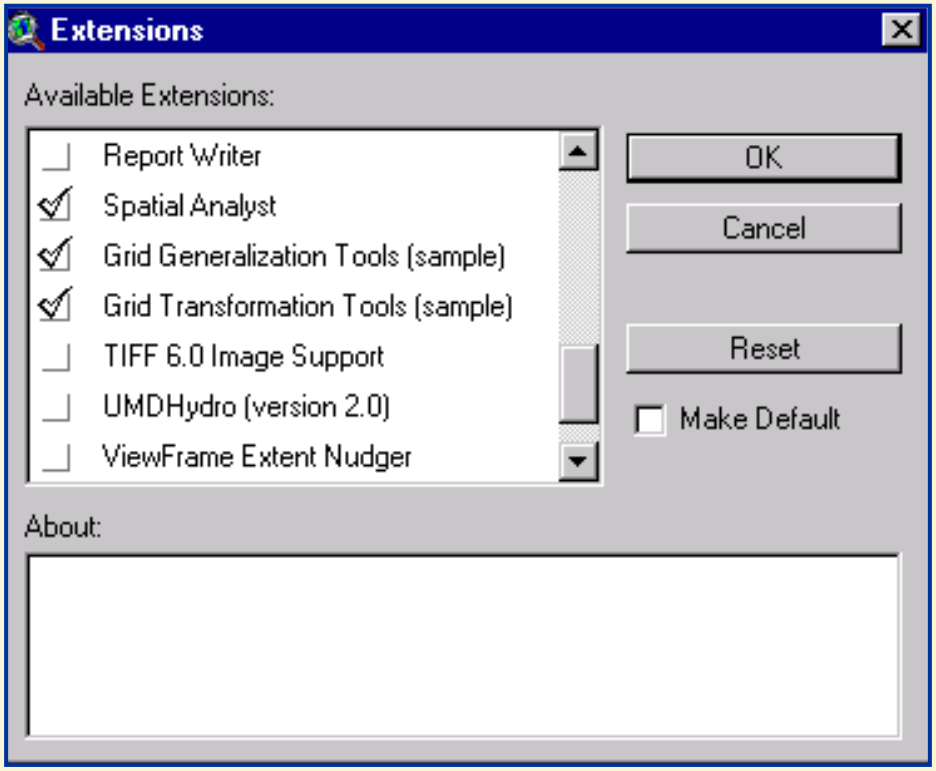


Decreasing the cell size to improve accuracy will greatly increase file size.

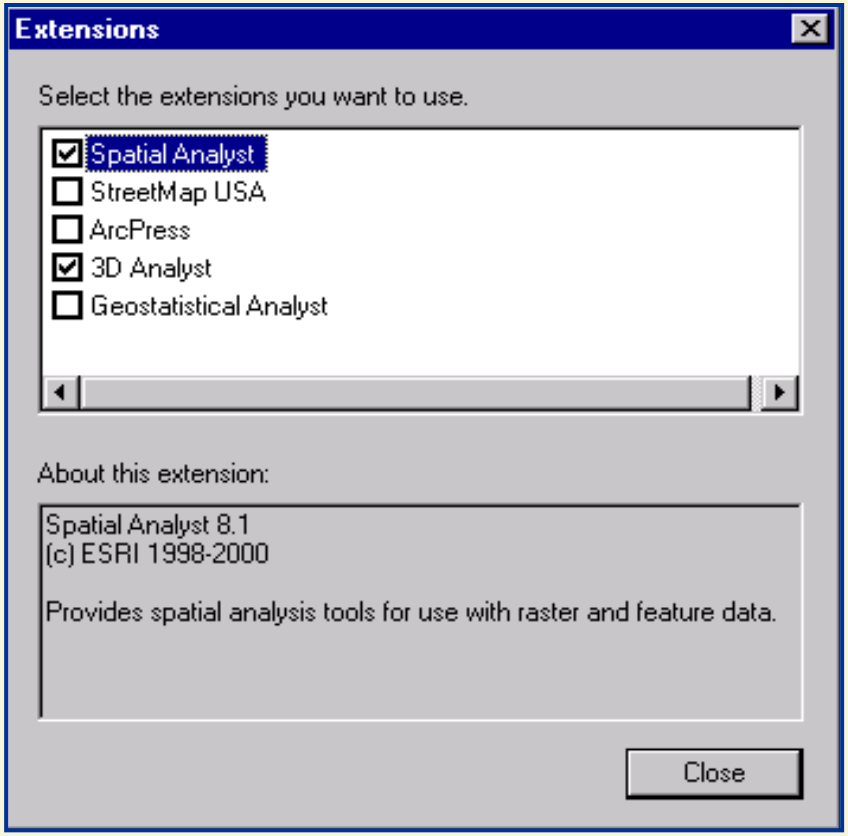
Utilizing GRIDs in a GIS

ArcView 3.2 and 8.1 require Extensions to use GRID data.

Turning on an Extension in AV 3.2

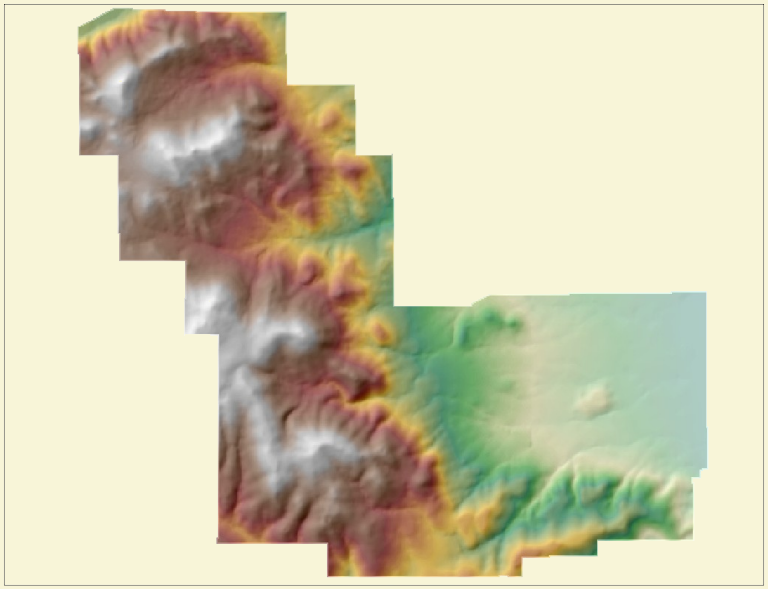


Turning on an Extension in ArcGIS 8.



Spatial Analyst

Spatial Analyst is the main Extension required for working with GRIDs.



Spatial Analyst provides a broad range of spatial modeling and analysis features:

- Create, query, map, and analyze cell-based raster data

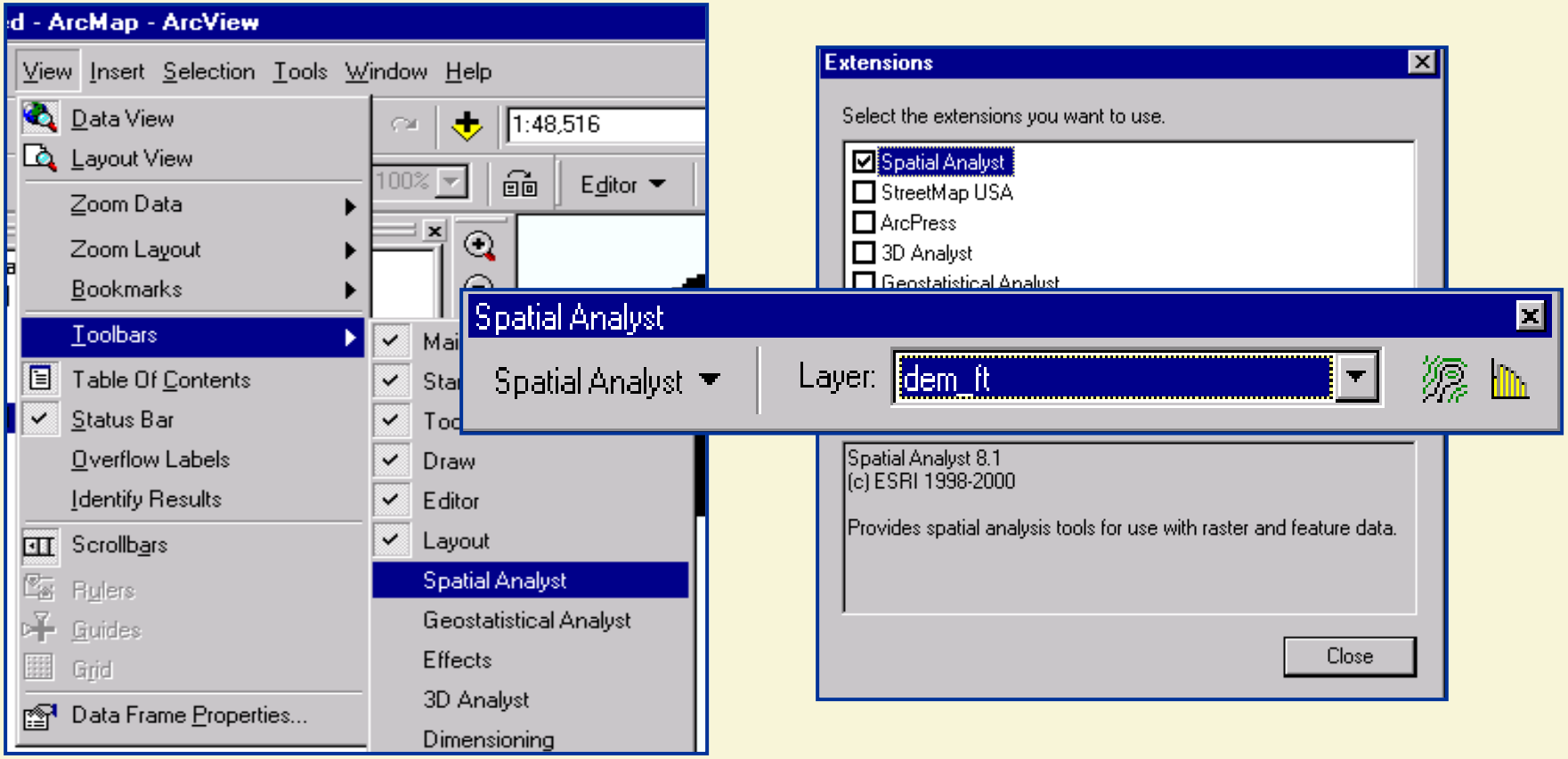
- Perform integrated raster/vector analysis

- Derive new information from existing data

- Query information across multiple data layers

Using Spatial Analyst

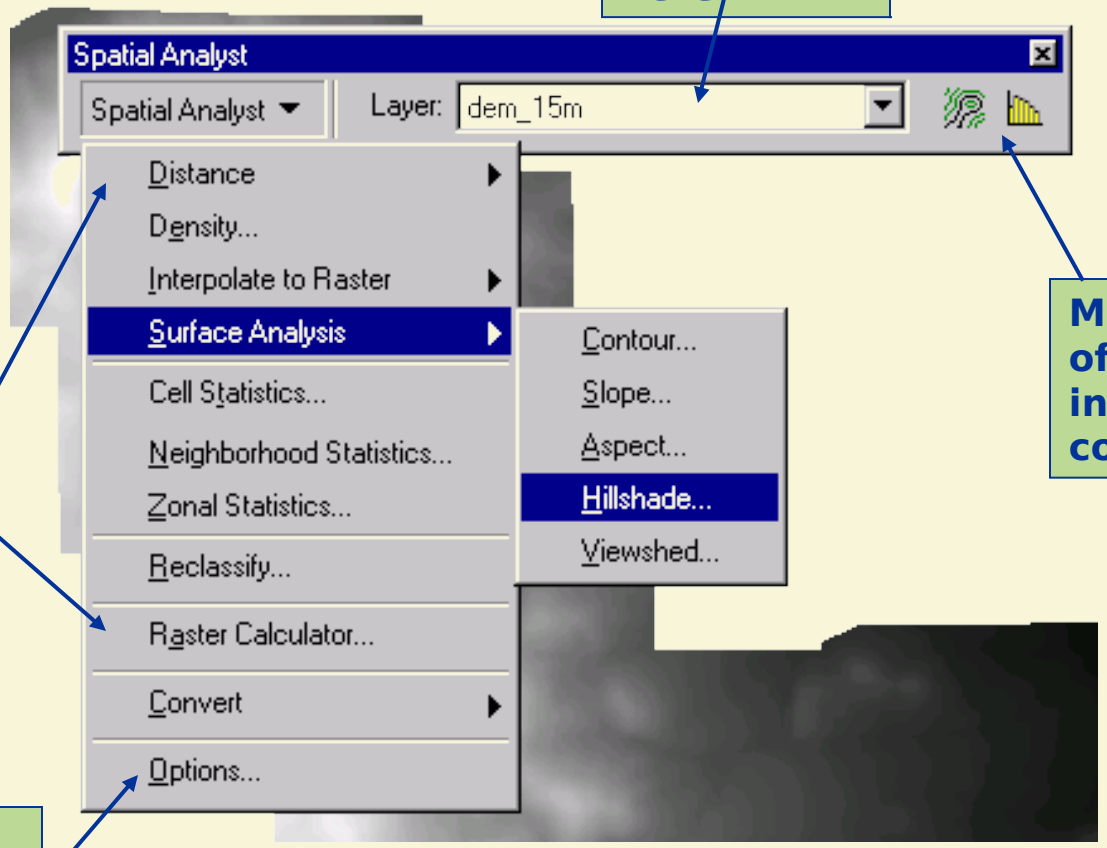
Select the Spatial Analyst Extension from the ArcGIS Extensions dia



After turning on Spatial Analyst, you must turn on its toolbar

Using Spatial Analyst

From the toolbar, you can utilize many functions of Spatial Analys



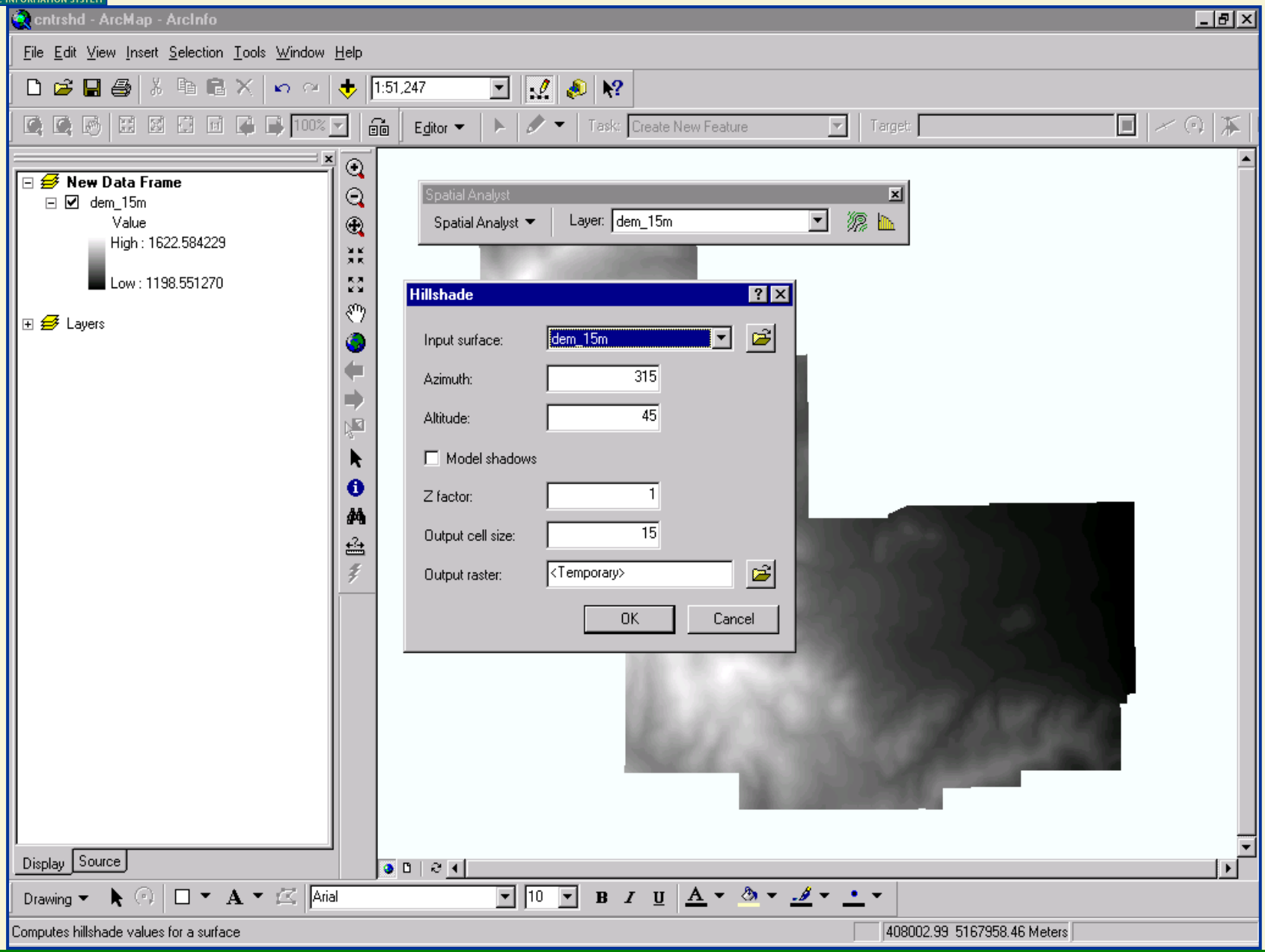
Choose your GRID here.

Make a histogram of your data, or interpolate contours.

Analysis and surface functions

Analysis properties can be set here

...for instance, to create a Hillshade from a DEM:

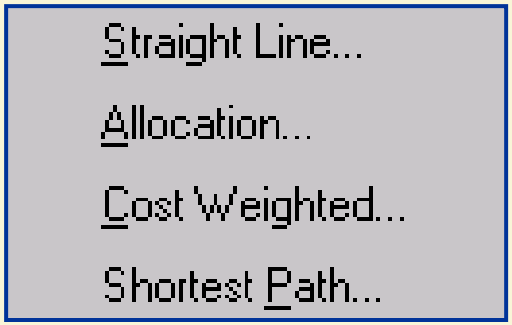


Hillshade

Analysis and Surface Functions

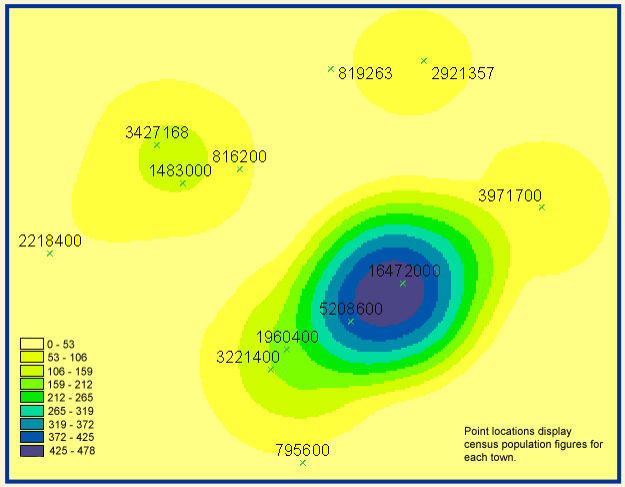
Distance functions

- Find the distance to the nearest drop zone from a point.
- Find all bivouac sites within 500 meters of a river.
- Determine the shortest (or least-cost) path from one location to another.



Density

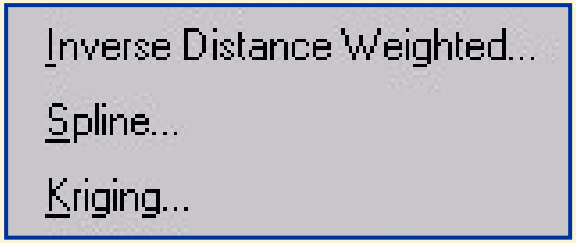
- Calculate species population per square kilometer from a point representing population.
- Use census point data to create a population density GRID for the area around an installation.



Population Density Map created from point data.

Interpolate to Raste

- Predict values for cells in a raster from a limited number of sample data points.
- Can be used to predict unknown values for:
  - elevation
  - rainfall
  - chemical concentrations
  - noise levels
  - etc.



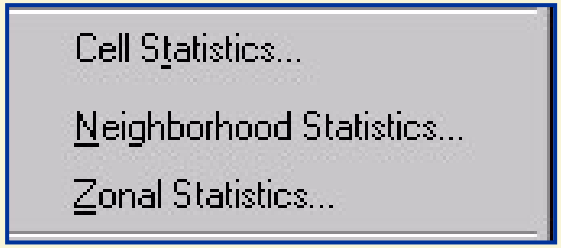
Analysis and Surface Functions

Surface Analysis

- Derive additional information from a DEM.
- Explore topographic variations in the landscape.
- Analyze visibility for an existing or proposed observation point.

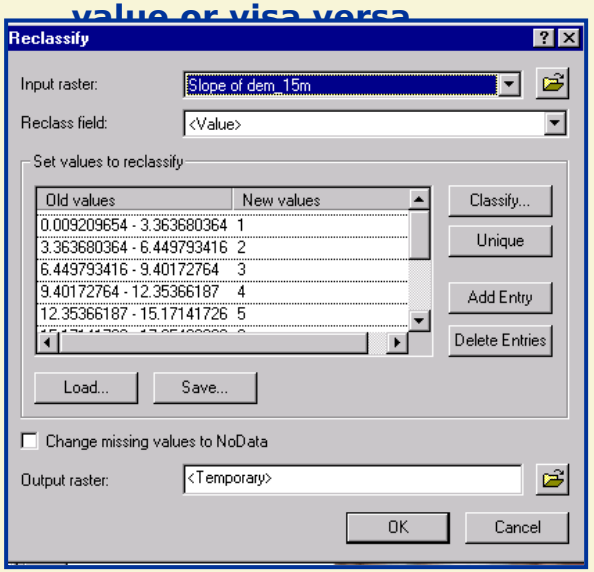
Statistics

- Compute the mean value of rainfall in a GRID cell over time.
- Calculate the variety of different land cover types in each neighborhood of a GRID.
- Calculate the mean elevation for each vegetation zone on an installation.



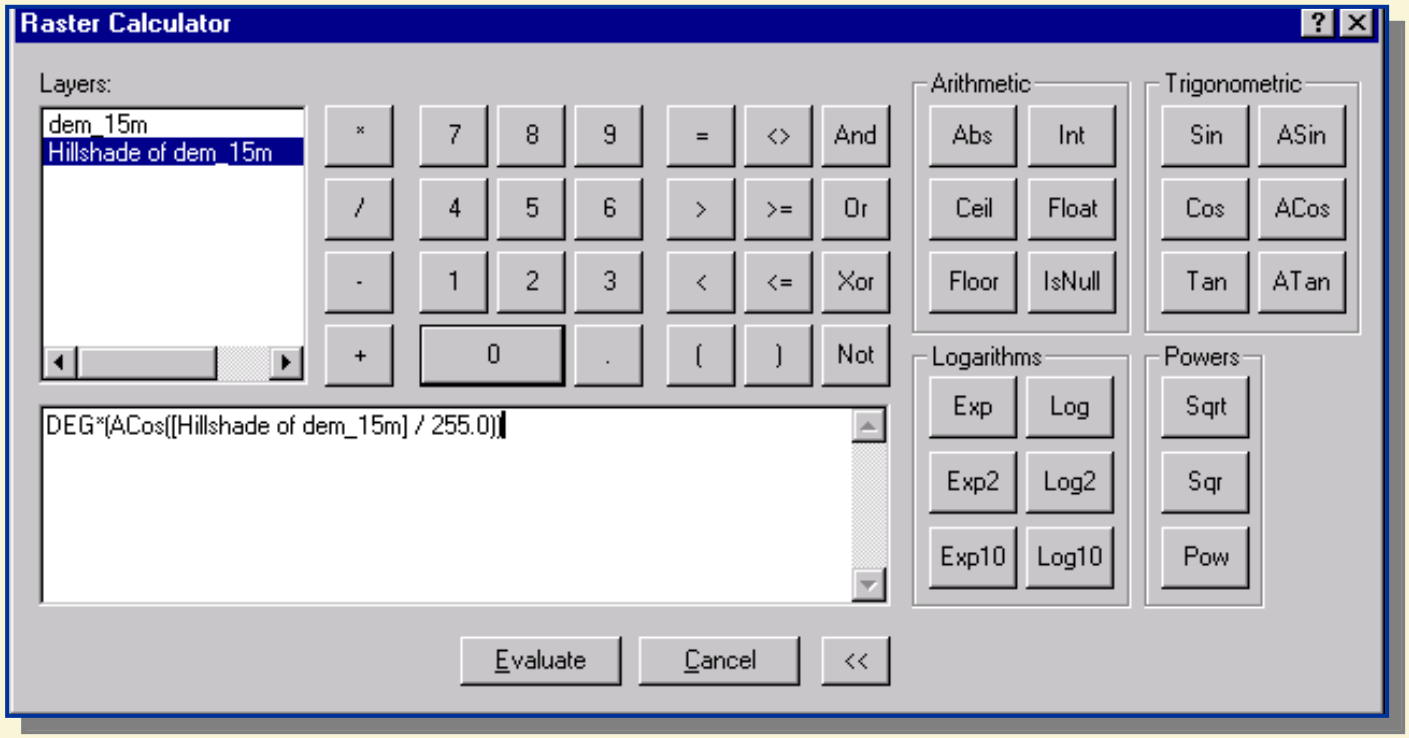
Reclassify

- Update an old GRID value with a new value.
- Group or combine data values.
- Reclassify to give GRID values an ordinal value.
- Replace NoData values with a numeric value or visa versa



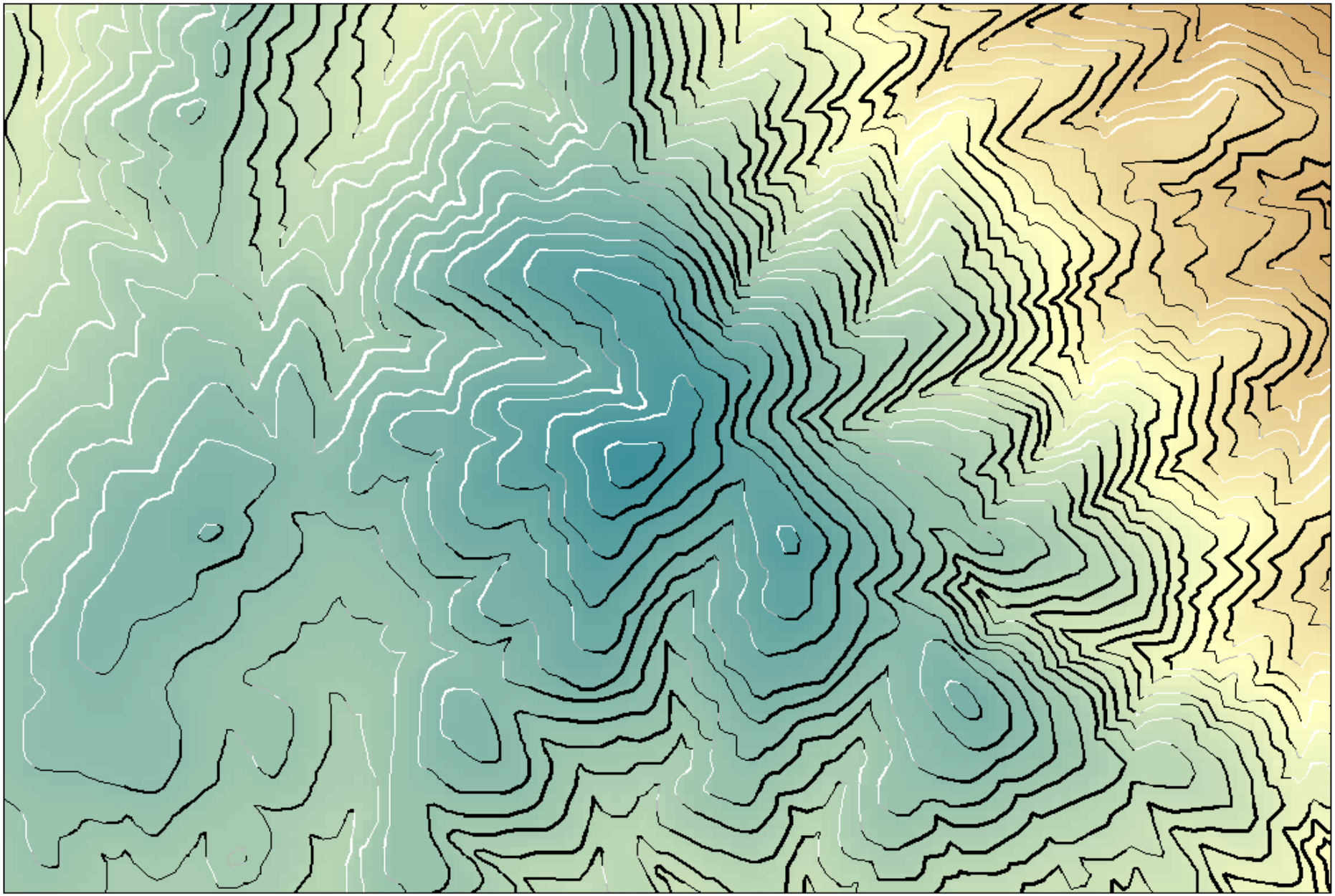
Raster Calculator

- Perform mathematical calculations using operators and functions
- Set up selection queries
- Type in and execute Map Algebra syntax.

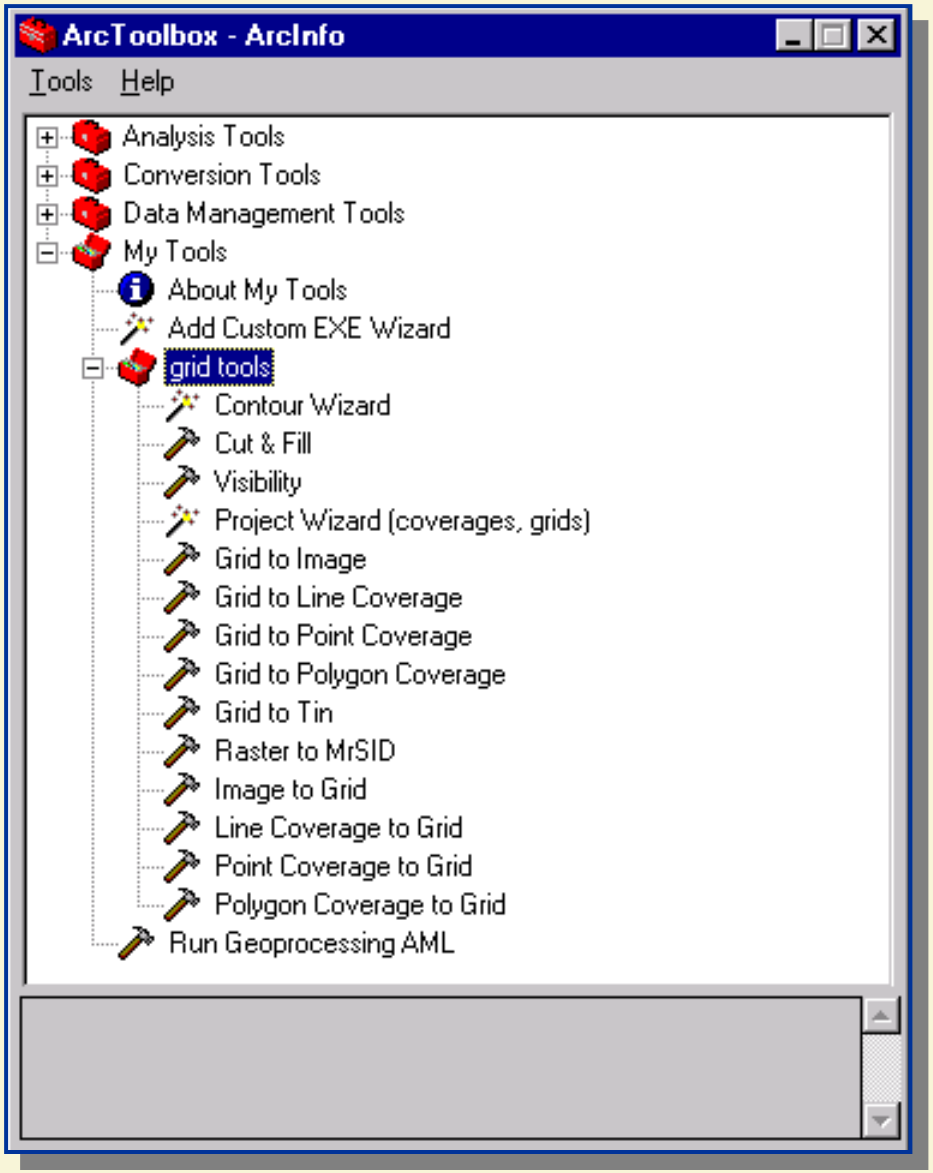


Such an expression can be used to create an output like this:

Illuminated Contour Map



Additional GRID tools available through ArcToolbox

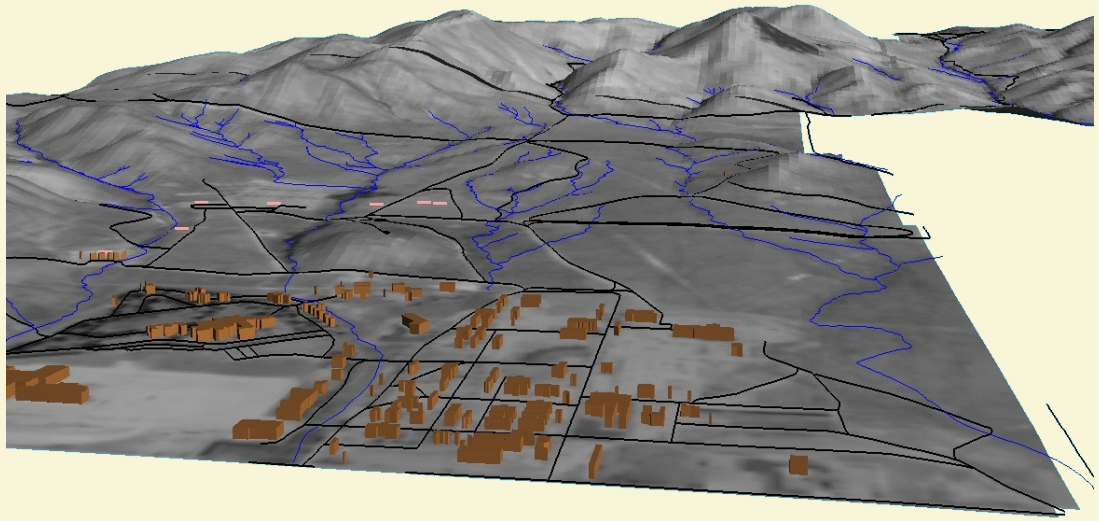


These tools and Wizards provide more GRID functionality and allow you to convert GRIDs to other formats.

3D Analyst

Extending the functionality of a GRID

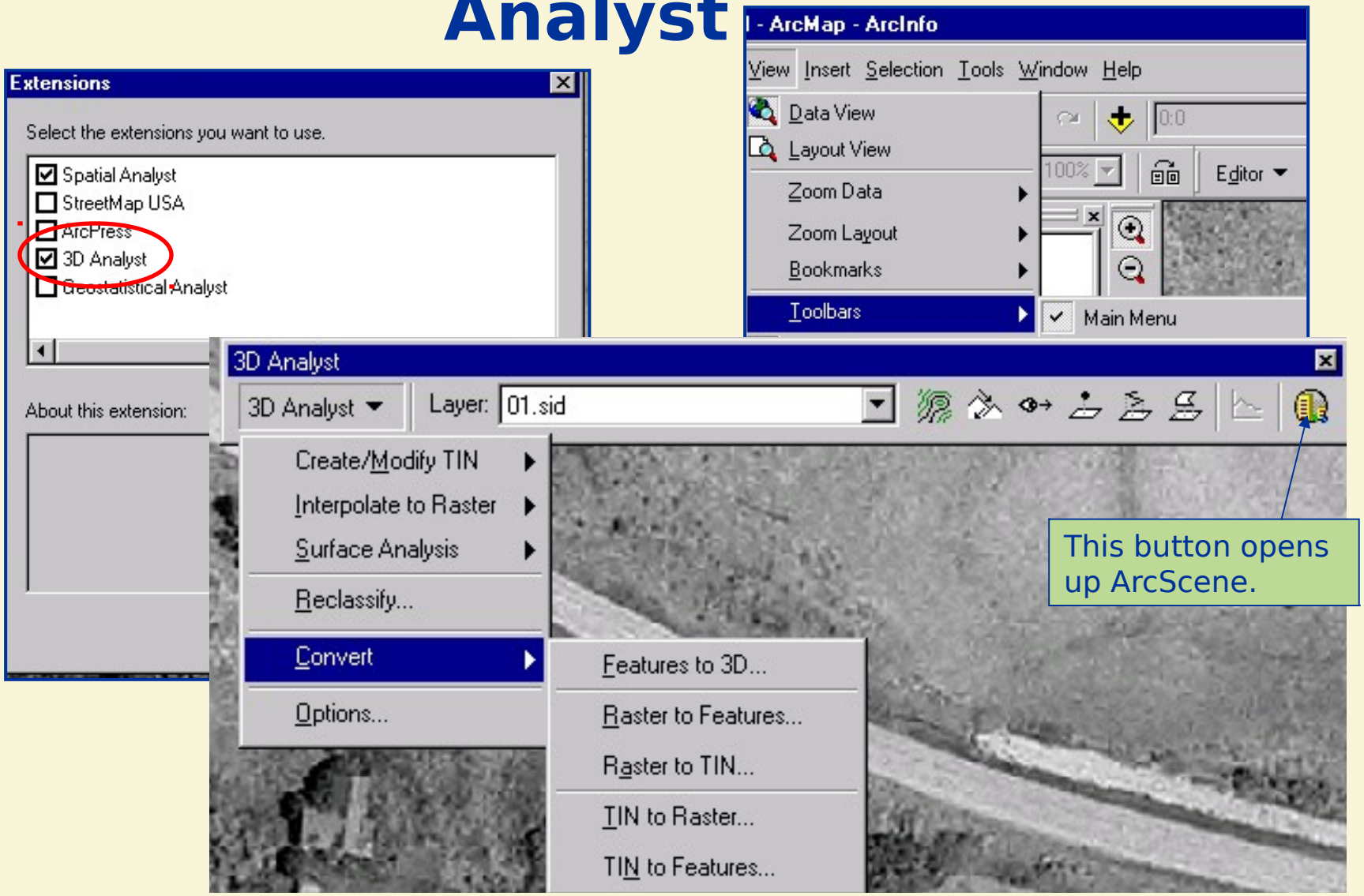
3D Analyst can be used to further analyze and visualize GRID data.



The 3D Analyst Extension gives you the ability to:

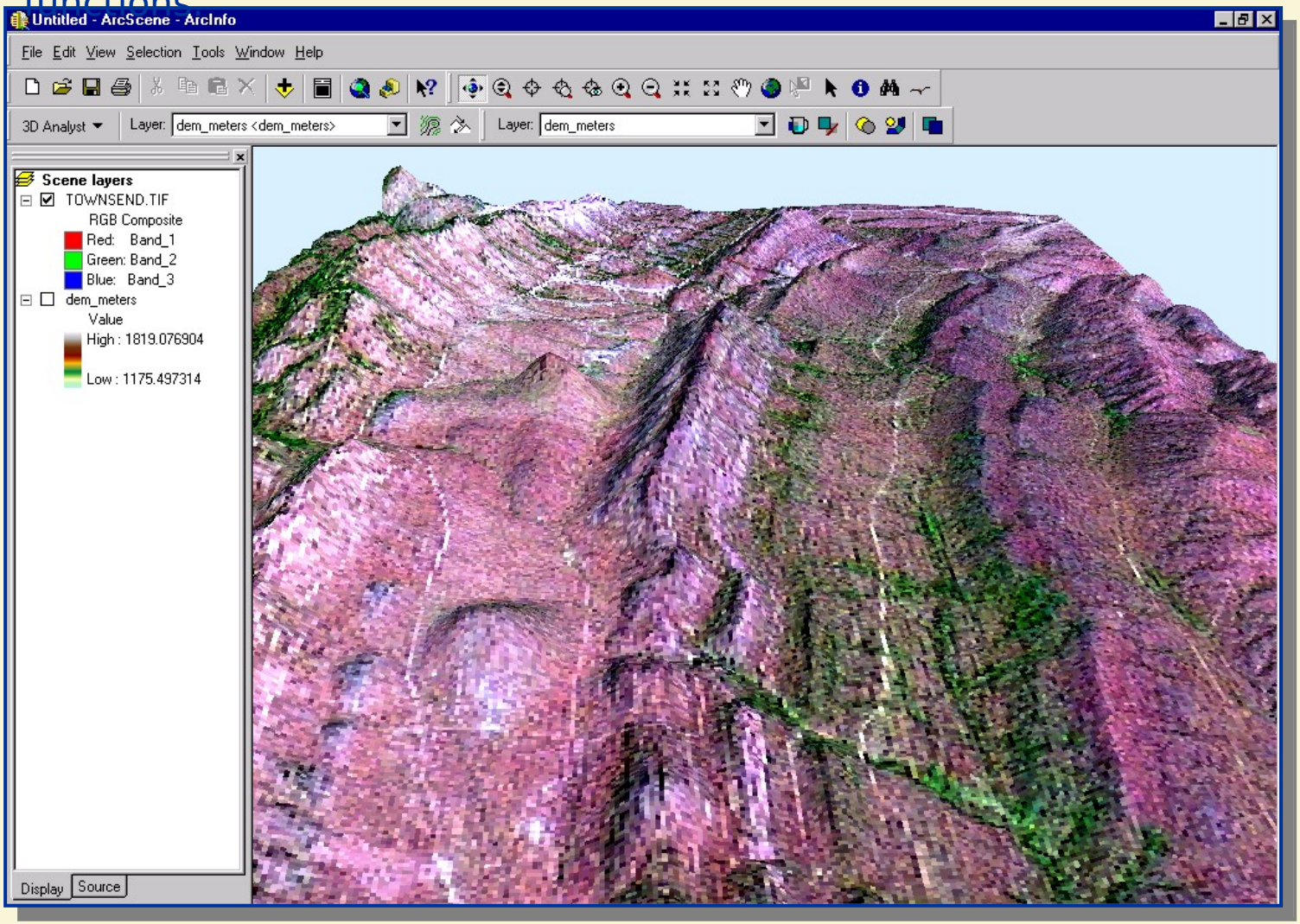
- **View a surface from multiple viewpoints.**
- **Query a surface.**
- **Determine what is visible from a chosen location.**
- **Create a realistic perspective image by draping raster and vector data over a surface.**

Using 3D Analyst



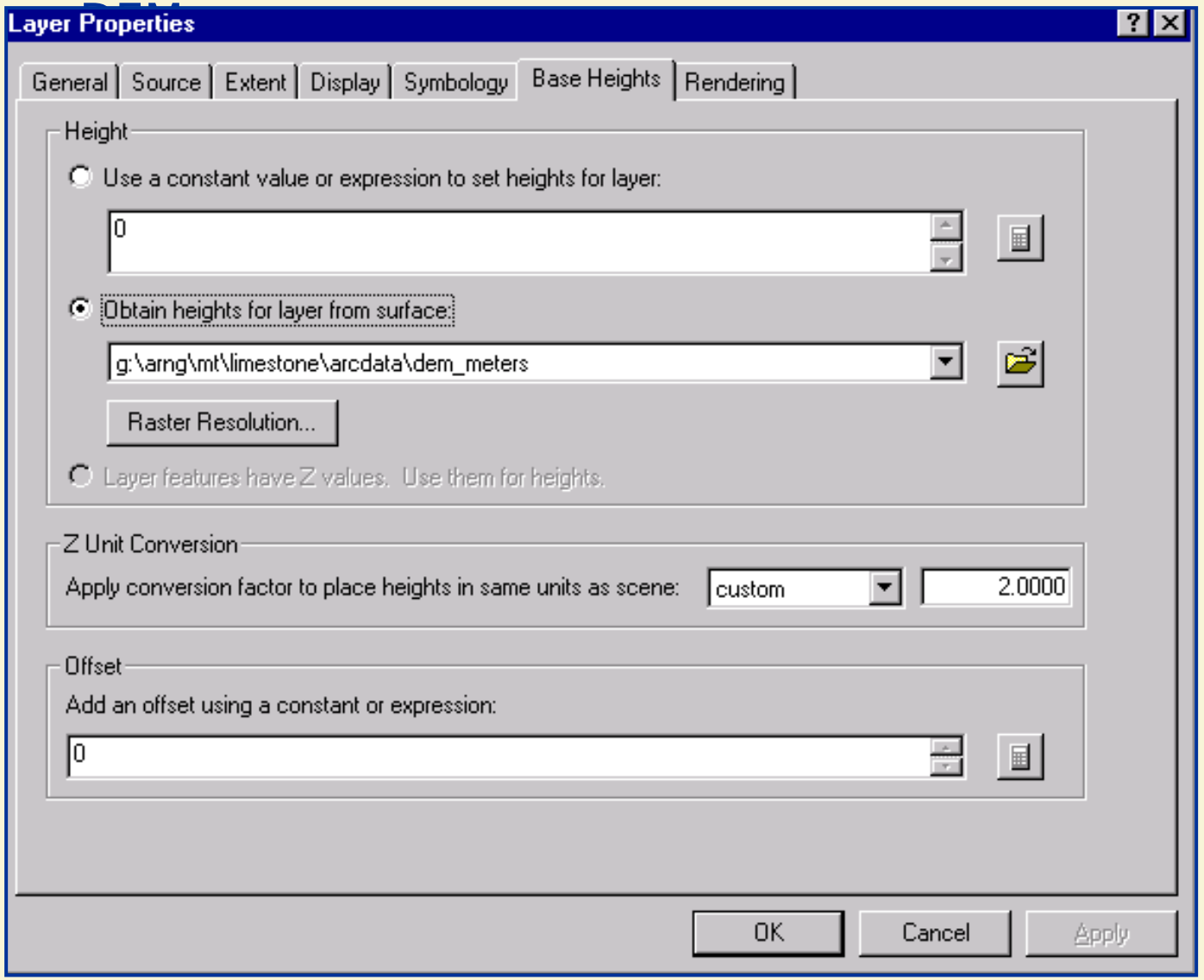
ArcScene is the core application of 3D Analyst.

With ArcScene you can display data in 3D and perform analytical functions.



Displaying GRID data in 3D

Assign base heights from the value field of a DEM



The Benefits of 3D Analyst

Visualization

- Perform interactive perspective viewing for presentation, analysis, or export for display on the Web.

- Model real-world surface features such as buildings and roads.

- Model subsurface features —wells, mines, groundwater, and underground storage facilities.

- Drape raster data on surfaces and view in 3D.

- Apply Z factor to GRID on the fly.

The Benefits of 3D Analyst

Analysis

- Generate 3D surfaces on the fly from attributes.
- Calculate slope, aspect, and hillshade for a surface.
- Generate contours as 2D or 3D shapes.
- Perform viewshed and line-of-sight analysis, spot height interpolation, profiling, and steepest path determination.
- Query 3D data based on attribute or location.
- Calculate 2D area, surface area, and volume relative to a given reference plane.

Raster in Action...

- Viewshed Analysis
- Error Checking
- 3-D Terrain Modeling

Useful Arcview 3.2 Extensions

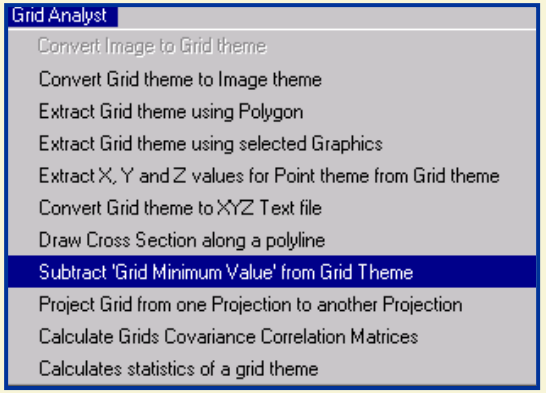
Many of you are probably still using ArcView 3.2 and will be for the foreseeable future.

Here are a number of Extensions that can be downloaded from the ArcScripts page of the ESRI Website. They expand the functionality of Spatial and 3D Analyst.

Useful Arcview 3.2 Extensions for Spatial Analyst

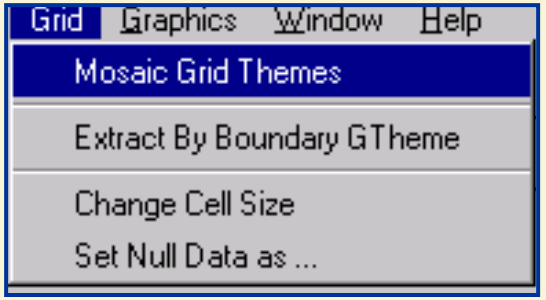
GRID Analyst Extension 1.1

This Extension converts GRID to an image, an image to GRID , extract GRID using polygon & graphics, XYZ values for point theme from GRID and several GRID operations.


Grid Analyst
Convert Image to Grid theme
Convert Grid theme to Image theme
Extract Grid theme using Polygon
Extract Grid theme using selected Graphics
Extract X, Y and Z values for Point theme from Grid theme
Convert Grid theme to XYZ Text file
Draw Cross Section along a polyline
Subtract 'Grid Minimum Value' from Grid Theme
Project Grid from one Projection to another Projection
Calculate Grids Covariance Correlation Matrices
Calculates statistics of a grid theme

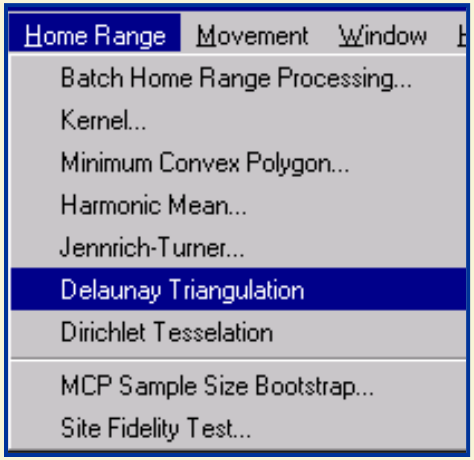
GRID Utilities

1. Mosaic more than two GRID Themes together. 2. Extract GRID Theme by existent Boundary GRID, Rectangle , Polygon, Circle, Input boundary rectangle coordinates and the selected shape of the Active Polygon FTheme. 3. Change Cell Size of GRID Theme. 4. Set Null data of GRID Theme to user inputted value.



UM D Hydro 2.0

Supports hydrological modeling and USGS Peak Discharge Calculations



Animal Movement

Set of tools for the analysis of animal movement patterns.

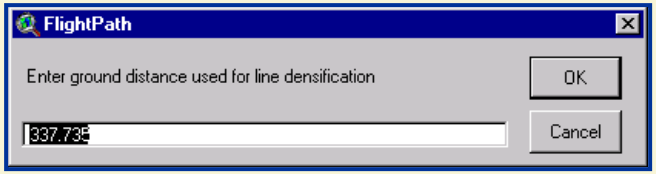
Useful Arcview 3.2 Extensions for 3D Analyst

3D - Add buildings to TIN surfaces

This Extension allows you to add features from a building foot-print shapefile to a tin surface. You can apply building heights from either a field in the feature table or apply a constant height to all features.

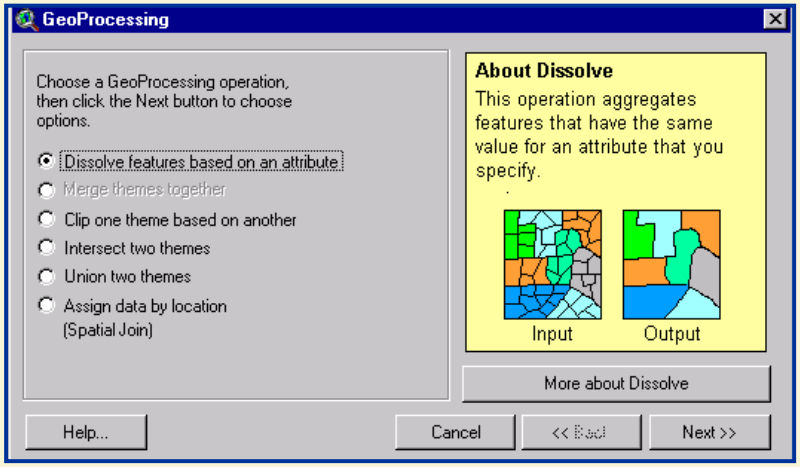
This is useful if you want to incorporate structures when doing visibility analysis, or when draping images over surfaces.

Flight Path Generator



This tool takes a user digitized polyline, densifies the vertices, smoothes the turns, then uses the result as a flight path to animate an associated 3D scene viewer.

Geoprocessing - M & Z Shapes


GeoProcessing
Choose a GeoProcessing operation, then click the Next button to choose options.
Dissolve features based on an attribute
Merge themes together
Clip one theme based on another
Intersect two themes
Union two themes
Assign data by location (Spatial Join)
About Dissolve
This operation aggregates features that have the same value for an attribute that you specify.
Input
Output
More about Dissolve
Help...
Cancel
<< Back
Next >>

An updated version of the standard ESRI Geoprocessing Extension. The Merge function has been enhanced to handle all measured and 3D shape types. The output of the Merge function preserves completely the shape types of the input themes. Although the Clip, Intersect and Union functions work on measured and 3D shapes, as well, the output from these functions are regular polylines and polygons (no M or Z values).